

## PATENT ABSTRACTS OF JAPAN

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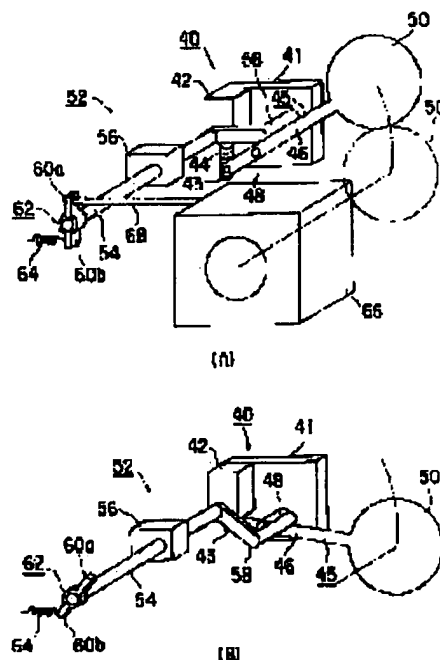
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## (54) ILLUMINATOR FOR MICROSCOPE

## (57)Abstract:

PURPOSE: To secure safety by using a simple and compact mechanism.

CONSTITUTION: A hook arm 58 capable of abutting on a shutter member 45 coupled with a solenoid 42 and closing an optical path is rotatably supported with a shaft 54 as center. A fin element 62 is attached to the tip of the shaft 54 and a tension spring 64 whose energizing force is larger than that of a spring for return 44 of the solenoid 42 is coupled with a lower fin 60b. For instance, a push rod 68 capable of abutting on an upper fin 60a is attached to one side of an optional interchangeable unit 66 such as an aperture-stop unit.



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**CLAIMS**

[Claim(s)]

[Claim 1] In the lighting system for microscopes which possesses the body of a microscope which contains a field-diaphragm unit, an aperture-diaphragm unit, and a filter switch unit at least on an optical path until it results [ from the light source ] in a sample As opposed to said body of a microscope At least one illumination-light study system unit in which attachment and detachment and exchange are possible, The electric shutter equipment which has the electro-technical element which operates electrically the shutter member which opens and closes said optical path at the time of said illumination-light study system unit insertion and detachment, and this shutter member, The lighting system for microscopes characterized by providing the mechanical device mechanically connected with said shutter member, and the external device which operates said mechanical device from the outside of said body of a microscope so that said shutter member may open and close said optical path according to insertion and detachment of said illumination-light study system unit.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the lighting system equipped with shutter equipment for optical microscopes.

[0002]

[Description of the Prior Art] It is common that the shutter equipment which opens and closes the optical path of an illumination-light study system for illumination-light control is conventionally formed especially in incident light fluorescence observation also in an optical microscope from a viewpoint of protection over the tenebrescence prevention and the sample by the superfluous exposure of the fluorescence to the sample at the time of fluorescence observation.

[0003] For example, an interlocking device is formed between a filter block and the shutter member of shutter equipment, and the shutter equipment which becomes unable to open and close a shutter member mechanically according to the force from the outside which human being gives is indicated by JP,62-16911,U ("the 1st conventional example" is called hereafter).

[0004] Moreover, a mechanical device is electrically operated using an external device, and the electric shutter equipment which can open and close a shutter is indicated by JP,63-189847,A ("the 2nd conventional example" is called hereafter).

[0005] There is also electric shutter equipment which furthermore improves the 2nd conventional example and operates by a certain sensor.

[0006] Next, the example of a configuration of a common optical microscope is shown in drawing 1.

[0007] a sign 1 and a sign 11 -- for example, the light source like a halogen lamp or a mercury lamp, a sign 2, and a sign 12 -- a collector lens, a sign 3, and a sign 13 -- for example, the filter, the sign 5, and sign 16 for modulated light in a well-known electric shutter for illumination-light control, a sign 4, and a sign 14 which are indicated by the 2nd conventional example -- in a condenser lens and a sign 8 a stage and a sign 9 show a sample and, as for a field diaphragm, a sign 6, and a sign 15, a sign 10 shows an aperture diaphragm and a sign 7 ] objective lens, respectively. Moreover, a sign 17 shows the cube unit held possible [ change-over insertion and detachment in an optical path ] according to the speculum method, and has for example, a fluorescence cube (an excitation filter, a dichroic mirror, absorption filter), an incident light light field cube (half mirror) or an incident light dark field cube (extracting mirror), etc. as this unit. In order for a sign 18 to accept to an image formation lens, and for a sign 19 to accept the need and to switch an optical path to an observation system or a photography system, in the ocular for photography, and a sign 22, a microscope frame and a sign 23 show the power source of the light source 11, and, as for the beam splitter and sign 20 which have been arranged possible [ insertion and detachment in an optical path ], a sign 24 shows [ an ocular and a sign 21 ] a body power source.

[0008] When performing the usual incident light fluorescence observation, it is condensed with the collector lens 12, and the light which came out from the light source 11 is led to a shutter 13, and is controlled by closing motion here. It is \*\*\*\*\* to the fluorescence cube which an

aperture diaphragm 15 and a field diaphragm 16 will be passed, and will be an example of the cube unit 17 if opened. This fluorescence cube is equipped with the excitation filter 25, the dichroic mirror 26, and the absorption filter 27. a field diaphragm 16 -- \*\*\*\* -- him -- \*\*\*\* -- an absorption filter 27 -- a passage -- a dichroic mirror 26 -- reflecting -- having -- an objective lens 10 -- a sample 9 -- \*\*\*\*\* -- a sample 9 is excited. The fluorescence emitted from this sample 9 is \*\*\*\*\* to the eyepiece optical system or photograph optical system which it is condensed with an objective lens 10, and a dichroic mirror 26 and an absorption filter 27 are passed, and it is condensed with the image formation lens 18, and is not illustrated.

[0009] As for field diaphragms 5 and 16 and aperture diaphragms 6 and 15, being fixed is common also in the illumination-light study system in an above-mentioned configuration. As mentioned above as an exchangeable illumination-light study system cube unit on the other hand, a fluorescence cube, an incident light light field cube, an incident light dark field cube, etc. are raised.

[0010] Usually, although observation is performed with the above configurations, the case where a special configuration is taken depending on application can be considered. For example, by the usual field diaphragm, a pinhole is placed instead of being a field diaphragm 16, since a limitation is in the diameter of min to limit the excitation light exposure range on a sample to the degree of pole. Moreover, in order to put in the lighting of laser etc. from the illumination-light way middle to give a certain actuation with laser etc. to a sample before observation (Fluorescence Recovery after Photobleaching etc.), a half mirror, a dichroic mirror, etc. are placed into an optical path. Moreover, when it is except fluorescence observation and uses the above-mentioned illumination-light study system, contrast may be given to fluorescence from a sample. In order to acquire contrast, an aperture diaphragm is usually narrowed down, but in using a twice [ high ] as many objective lens as this etc., in order to raise effectiveness further, a pinhole may be established in the location of an aperture diaphragm.

[0011] In order to satisfy such applications, as shown in drawing 2, a configuration is not only changed easily, but it can add easily the function like Japanese Patent Application No. No. 317100 [ three to ] by these people by replacing each function the whole unit to a unit configuration, then the body frame 22. The mirror unit in which it extracted and the unit and the pinhole unit in which the sign 32 included the pinhole 35 also containing the breaker style which does not illustrate the sign 31 of drawing 2 including an aperture diaphragm 15 or a field diaphragm 16, and the sign 33 contained the half mirror or the dichroic mirror 36 is shown. By attaching these units in the anchoring section 34 of a body frame, it is inserted all over an illumination-light way, and the optical function corresponding to the above various applications is achieved.

[0012] In addition, the application shown in drawing 2 is an example, and should just be an object which achieves a function by inserting in an optical path.

[0013] Considering the condition of having removed the above-mentioned unit here, the hole of the anchoring section 34 is opening the body frame side, and the optical path serves as nakedness. In this case, when the thing of high brightness like especially a mercury-vapor lamp and high energy is used as the light source 11 as it is in the condition which the light source 11 turned on, the inside of an optical path is a remarkable elevated temperature, and when a hand etc. is put in accidentally, there is a danger of getting injured. Moreover, since a lot of ultraviolet-rays light has come out at the time of incident light fluorescence observation, when it continues basking in leakage light, there is risk of doing damage to the body. However, since a certain amount of time amount is taken to be stabilized, a lamp life also becomes short and the discharge tubes, such as a mercury-vapor lamp, do not turn to repeating flashing, it is desirable [ for this reason, at the time of unit exchange, it must cope with turning off a power source etc., but ] for as to have made the light switch on.

[0014] So, in case a unit is removed, it is possible to close the electric shutter 13 shown in drawing 1. That is, attachment and detachment of said unit are sensed by a certain electric sensor which is not illustrated, and if it energizes to the solenoid which drives a shutter member, since the illumination light can be intercepted in the case of unit exchange, safety is secured

when exchanging the unit of an optical-path lower stream of a river from a shutter.

[0015] However, since the power source of a sensor and an electric shutter is being interlocked with the power source by the side of a body when moving a shutter member electrically by sensing of an electric sensor in this way, if the power source by the side of a body is shut off, effect is not taken at all. Generally, whenever [ luminosity /, such as a mercury-vapor lamp, ], the light source has the independent power source 23, and lighting of it is attained regardless of the power source of a body. Moreover, in the field which measures the minute current of samples, such as electrophysiology, since it becomes a noise, a body is turned off and observation is performed. Thus, under the situation of turning off and using the power source of a body, safety is not securable with electric actuation at the time of unit exchange.

[0016] Moreover, it may change into the condition of having opened the optical path, with the light source given without taking down a shutter, while the shutter equipment only using a mechanical device had bad operability and the light source had stuck, without using an electric means, and unit exchange may be carried out.

[0017] It aims at offering the lighting system for microscopes with which safety was secured by using an easy and small device, this invention having been made in view of the above actual condition, and maintaining the effectiveness of a Prior art. In a detail, an aperture diaphragm and a field diaphragm take a unit configuration, and illumination light study system cube units, such as a dichroic mirror, and exchange be possible in it, and regardless of a power source, it interlock at the time of unit exchange, a \*\*\*\*\* shutter open and close, and it aim at offer the lighting system for microscopes possessing the electric shutter of a device easy [ a configuration which do not make the leakage light of the light source which have damage in a speculum top or the body, and the harmless light source emit ], and mechanical.

[0018]

[Means for Solving the Problem] Therefore, this invention is set to the lighting system for microscopes which possesses the body of a microscope which contains a field-diaphragm unit, an aperture-diaphragm unit, and a filter switch unit at least on an optical path until it results [ from the light source ] in a sample. As opposed to said body of a microscope At least one illumination-light study system unit in which attachment and detachment and exchange are possible, The electric shutter equipment which has the electro-technical element which operates electrically the shutter member which opens and closes said optical path at the time of said illumination-light study system unit insertion and detachment, and this shutter member, The lighting system for microscopes characterized by providing the mechanical device mechanically connected with said shutter member, and the external device which operates said mechanical device from the outside of said body of a microscope so that said shutter member may open and close said optical path according to insertion and detachment of said illumination-light study system unit.

[0019]

[Function] In case the body of a microscope inserts [ unit / illumination-light study system ], an optical path is mainly opened and closed by electric shutter equipment. For example, when electric shutter equipment does not operate, and an external device operates a mechanical device at the time of insertion and detachment of an illumination-light study system unit, a shutter is moved, and an optical path is opened [ since the body of a microscope is turned off ] and closed.

[0020]

[Example] With reference to an accompanying drawing, one example of this invention is explained below.

[0021] Drawing 3 shows the electric shutter equipment 40 used for the lighting system for microscopes of the 1st example of this invention. In addition, since the configuration of those other than the electric shutter equipment 40 circumference has taken the almost same configuration as the conventional lighting system explained by drawing 1 and drawing 2, the lighting system of this example explains only the configuration of the electric shutter equipment 40 circumference by this example.

[0022] This electric shutter equipment 40 has the shutter base 41. This shutter base 41 is being

fixed to the body frame of a lighting system. The solenoid 42 is being fixed to this shutter base 41. This solenoid 42 has the plunger 43 and this plunger 43 is movable between the suction location by the side of a solenoid 42, and the return location which projects from a solenoid 42. If energization is made by the solenoid 42, a plunger 43 will be attracted in an electromagnetic operation of a solenoid 42 in a suction location. Between this plunger 43 and solenoid 42, the spring 44 for a return which consists of a compression coil spring is arranged. This halt of the energization to a solenoid 42 returns a plunger 43 to a return location.

[0023] The end face section of the lever 46 of the shutter member 45 is supported pivotably by the point of a plunger 43. Fitting of the shaft 48 fixed to the shutter base 41 is carried out to the section in the middle of this lever 46, and the lever 46 is supported by the shutter base 41 rotatable centering on this shaft 48. The disc-like shutter plate 50 is formed in the point of a lever 46 in one.

[0024] In the condition of not energizing to a solenoid 42, since the plunger 43 is brought to the return location according to the energization force of the spring 44 for a return, the shutter member 45 is held in the location from which it separated from the optical path as a continuous line showed drawing 3. By energizing to a solenoid 42, a plunger 43 resists the energization force of the spring 44 for a return, it is drawn in in a suction location, and the shutter member 45 moves to the location which rotates a shaft 48 as a core and is shown according to the two-dot chain line in drawing. In this location, the shutter plate 50 is inserted into an optical path, and intercepts a beam of light.

[0025] The mechanical breaker style and mechanical external device which are interlocked with such electric shutter equipment 40 are shown in drawing 4.

[0026] As shown in (A) of drawing 4, the mechanical breaker style 52 has the revolving shaft 54. Bearing of this revolving shaft 54 is carried out pivotable by the bearing 56 fixed to the body frame. The end section of this revolving shaft 54 is located near the solenoid 42, and the hook arm 58 which can contact the lever 46 of the shutter member 45 has fixed in this end section. This hook arm 58 is rotated by the revolving shaft 54 and one.

[0027] In the other end of a revolving shaft 54, the fin element 62 which has the upper part and two fins 60a and 60b which extended caudad, respectively has fixed. The end section of an extension spring 64 is connected with fin 60b of the lower part of this fin element 62. The other end of this hauling coiled spring 64 has fixed on the body of a lighting system which is not illustrated.

[0028] The push rod 68 fixed to one side face of the unit 66 of the arbitration of the exchangeable units shown in drawing 2 and contact are possible for upper fin 60a of the fin element 62. This push rod 64 constitutes a part of external device.

[0029] The operation is explained in the above configuration. The configuration of this mechanical breaker style 52 is used together with electric shutter equipment 40, is prepared, and as shown in (A) of drawing 4, in the condition that the unit 66 of arbitration is inserted in the optical path, upper fin 60a is pushed by the push rod 68, and it is in the condition of the revolving shaft 54 having pulled and having rotated against the energization force of coiled spring 64. Consequently, the hook arm 58 is estranged from the lever 46 of the shutter member 45, and electric actuation of arbitration is possible for electric shutter equipment 40.

[0030] In order to exchange a unit 66 in this condition, when a unit 66 is removed from an optical path, a push rod 68 estranges from upper fin 60a, the fin element 62 pulls, and it rotates according to the energization force of coiled spring 64. Then, as shown in (B) of drawing 4, a revolving shaft 54 rotates with the fin element 62, and, as for a revolving shaft 54 and the hook arm 58 of one, this lever 46 is rotated in contact with the lever 46 of the shutter member 45. In this case, by setting up the ability of the hauling coiled spring 64 so that the ability of the spring 44 (refer to (B) of drawing 4) for a return of a solenoid 42 may be excelled, a lever 46 is rotated until a plunger 43 reaches a suction location. That is, a lever 46 and the shutter plate 50 formed in one are inserted in an optical path, and intercepts light.

[0031] Furthermore, when the unit 66 of arbitration is inserted again, fin 60a is pushed by the tip of a push rod 68, and when the hook arm 58 rotates through the fin element 62 and a revolving shaft 54, the shutter plate 50 is automatically removed rather than an optical path according to

an operation of return and the spring 44 for a return by the condition which shows the hook arm 58 in (A) of drawing 4 .

[0032] According to the operation like \*\*\*\*, it is not scrupulous off, and ON of the power source of a body, and where the unit of arbitration is removed, since a shutter is closed, the safety at the time of unit exchange of arbitration is secured. Moreover, in the condition that the unit is inserted, the function of electric shutter equipment is not spoiled at all. Moreover, since the electric shutter equipment which is in an optical path conventionally is used, it ends by space-saving optically. Since such electric shutter equipment is combined with the easy mechanical device, it is cheap.

[0033] Next, the 2nd example is explained using drawing 5 thru/or drawing 7 . In addition, the same reference mark is given to the same member as the thing in the 1st example, and only a different place is explained.

[0034] It is possible that it uses the configuration of the 1st example according to the \*\*\*\* application which has, generally all over an illumination-light way, arranged three units of the field-diaphragm unit 16, the aperture-diaphragm unit 15, and the filter change unit 14 at least as shown in drawing 1 , and was mentioned above, combining although the mechanical breaker style 52 acts only on one specific unit. That is, safety must be secured also in case which of two or more units is detached and attached.

[0035] This example corresponds to such a request. That is, this example has the mechanical breaker style 52 which can respond to plurality 66 (66a, 66b, 66c), for example, three units, as shown in drawing 6 .

[0036] The revolving shaft 54 of this device 52 is supported by two bearings 56 pivotable. As shown in (A) of drawing 6 , it projects in the bottom peripheral surface of this revolving shaft 54, and the piece 70 is formed in it. The end section of the hauling coiled spring 64 is connected with this piece 70 of a protrusion.

[0037] As shown in drawing 5 , three fins 60 (60a, 60b, 60c) arranged in the location corresponding to three units 66 are formed in the upper peripheral surface of a revolving shaft 54. On these fins 60, the end face section of three compression coil springs 72 (72a, 72b, 72c) has fixed, respectively. In the point of these compression coil springs 72, three pieces 74 (74a, 74b, 74c) of contact which the push rod 68 (68a, 68b, 68c) of a unit 60 can contact have fixed, respectively. By the guidance means which is not illustrated, the piece 74 of these contact is guided so that it may be movable only in the migration direction of a push rod 68. Other configurations are the same as that of the 1st example.

[0038] The operation is shown in the above configuration. It is maintained at the condition which shows a revolving shaft 54 in (A) of (A) of drawing 6 , and drawing 7 if it is set up so that resultant force of three compression coil springs 72 may pull since the push rod 68 is pushing the piece 74 of contact as shown in (A) of drawing 5 and drawing 6 in the condition that both three units 66 are inserted in the optical path, and the ability of the spring coil 64 may be excelled, and the hook arm 58 does not affect the shutter member 45 at all.

[0039] Supposing it extracts unit 66 of one unit of arbitration, for example, center, b here, resultant force with three springs 72 will decrease. if ability of each compression coil spring 72 is set to A here and ability of the hauling coiled spring 64 is set to  $F - A + A + A > F$  and  $- A + A < F$  namely,  $-$  If an ability setup is carried out so that it may become  $A + A < F < A + A + A$ , when a unit escapes from at least one, it pulls and the ability F of a spring 64 excels, and a revolving shaft 54 rotates, and it will rotate the hook arm 58, hooking the shutter member 45. That is, the hook arm 58 is rotated until it is maintained at the condition which shows in (B) of drawing 6 , and (B) of drawing 7 .

[0040] In this condition, the shutter plate 50 of the shutter member 45 is inserted in an optical path, and intercepts light. Moreover, it is the same operation even when a unit 66 falls out to or more two coincidence. If all three units 66 will be again inserted in an optical path, return and the shutter member 45 will be in the condition which shows a revolving shaft 54 in (A) of drawing 6 , and (A) of drawing 7 in a free condition.

[0041] According to such a device, even if a unit is plurality, safety is secured in case the unit of an arbitrary throat is exchanged. moreover  $-$  since the electric shutter equipment originally

arranged optically was used together and it has realized by the easy device -- space-saving -- and it is cheap.

[0042] Moreover, although this example explained the breaker style 52 corresponding to three units, it is clear that it can be coped with by the same device also to still more numbers than this or a small number of units.

[0043] Moreover, although the two above-mentioned examples mainly explained epi-illumination, it is completely same that it is applicable also in transmitted illumination.

[0044]

[Effect of the Invention] In the lighting system which carried out unitization of the function of arbitration, the safety to the illumination light is always secured irrespective of turning on and off of a body power source in the case of unit exchange. Since reservation of this safety is performed by utilizing the electric shutter equipment used in the conventional technique, it can constitute equipment space-saving and cheaply.

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**TECHNICAL FIELD**

[Industrial Application] This invention relates to the lighting system equipped with shutter equipment for optical microscopes.

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## PRIOR ART

[Description of the Prior Art] It is common that the shutter equipment which opens and closes the optical path of an illumination-light study system for illumination-light control is conventionally formed especially in incident light fluorescence observation also in an optical microscope from a viewpoint of protection over the tenebrescence prevention and the sample by the superfluous exposure of the fluorescence to the sample at the time of fluorescence observation.

[0003] For example, an interlocking device is formed between a filter block and the shutter member of shutter equipment, and the shutter equipment which becomes unable to open and close a shutter member mechanically according to the force from the outside which human being gives is indicated by JP,62-16911,U ("the 1st conventional example" is called hereafter).

[0004] Moreover, a mechanical device is electrically operated using an external device, and the electric shutter equipment which can open and close a shutter is indicated by JP,63-189847,A ("the 2nd conventional example" is called hereafter).

[0005] There is also electric shutter equipment which furthermore improves the 2nd conventional example and operates by a certain sensor.

[0006] Next, the example of a configuration of a common optical microscope is shown in drawing 1.

[0007] a sign 1 and a sign 11 -- for example, the light source like a halogen lamp or a mercury lamp, a sign 2, and a sign 12 -- a collector lens, a sign 3, and a sign 13 -- for example, the filter, the sign 5, and sign 16 for modulated light in a well-known electric shutter for illumination-light control, a sign 4, and a sign 14 which are indicated by the 2nd conventional example -- in a condenser lens and a sign 8 a stage and a sign 9 show a sample and, as for a field diaphragm, a sign 6, and a sign 15, a sign 10 shows an aperture diaphragm and a sign 7 ] objective lens, respectively. Moreover, a sign 17 shows the cube unit held possible [ change-over insertion and detachment in an optical path ] according to the speculum method, and has for example, a fluorescence cube (an excitation filter, a dichroic mirror, absorption filter), an incident light light field cube (half mirror) or an incident light dark field cube (extracting mirror), etc. as this unit. In order for a sign 18 to accept to an image formation lens, and for a sign 19 to accept the need and to switch an optical path to an observation system or a photography system, in the ocular for photography, and a sign 22, a microscope frame and a sign 23 show the power source of the light source 11, and, as for the beam splitter and sign 20 which have been arranged possible [ insertion and detachment in an optical path ], a sign 24 shows [ an ocular and a sign 21 ] a body power source.

[0008] When performing the usual incident light fluorescence observation, it is condensed with the collector lens 12, and the light which came out from the light source 11 is led to a shutter 13, and is controlled by closing motion here. It is \*\*\*\*\* to the fluorescence cube which an aperture diaphragm 15 and a field diaphragm 16 will be passed, and will be an example of the cube unit 17 if opened. This fluorescence cube is equipped with the excitation filter 25, the dichroic mirror 26, and the absorption filter 27. a field diaphragm 16 -- \*\*\*\* -- him -- \*\*\*\* -- an absorption filter 27 -- a passage -- a dichroic mirror 26 -- reflecting -- having -- an objective lens 10 -- a sample 9 -- \*\*\*\*\* -- a sample 9 is excited. The fluorescence

emitted from this sample 9 is \*\*\*\*\* to the eyepiece optical system or photograph optical system which it is condensed with an objective lens 10, and a dichroic mirror 26 and an absorption filter 27 are passed, and it is condensed with the image formation lens 18, and is not illustrated.

[0009] As for field diaphragms 5 and 16 and aperture diaphragms 6 and 15, being fixed is common also in the illumination-light study system in an above-mentioned configuration. As mentioned above as an exchangeable illumination-light study system cube unit on the other hand, a fluorescence cube, an incident light light field cube, an incident light dark field cube, etc. are raised.

[0010] Usually, although observation is performed with the above configurations, the case where a special configuration is taken depending on application can be considered. For example, by the usual field diaphragm, a pinhole is placed instead of being a field diaphragm 16, since a limitation is in the diameter of min to limit the excitation light exposure range on a sample to the degree of pole. Moreover, in order to put in the lighting of laser etc. from the illumination-light way middle to give a certain actuation with laser etc. to a sample before observation (Fluorescence Recovery after Photobleaching etc.), a half mirror, a dichroic mirror, etc. are placed into an optical path. Moreover, when it is except fluorescence observation and uses the above-mentioned illumination-light study system, contrast may be given to fluorescence from a sample. In order to acquire contrast, an aperture diaphragm is usually narrowed down, but in using a twice [ high ] as many objective lens as this etc., in order to raise effectiveness further, a pinhole may be established in the location of an aperture diaphragm.

[0011] In order to satisfy such applications, as shown in drawing 2 , a configuration is not only changed easily, but it can add easily the function like Japanese Patent Application No. No. 317100 [ three to ] by these people by replacing each function the whole unit to a unit configuration, then the body frame 22. The mirror unit in which it extracted and the unit and the pinhole unit in which the sign 32 included the pinhole 35 also containing the breaker style which does not illustrate the sign 31 of drawing 2 including an aperture diaphragm 15 or a field diaphragm 16, and the sign 33 contained the half mirror or the dichroic mirror 36 is shown. By attaching these units in the anchoring section 34 of a body frame, it is inserted all over an illumination-light way, and the optical function corresponding to the above various applications is achieved.

[0012] In addition, the application shown in drawing 2 is an example, and should just be an object which achieves a function by inserting in an optical path.

[0013] Considering the condition of having removed the above-mentioned unit here, the hole of the anchoring section 34 is opening the body frame side, and the optical path serves as nakedness. In this case, when the thing of high brightness like especially a mercury-vapor lamp and high energy is used as the light source 11 as it is in the condition which the light source 11 turned on, the inside of an optical path is a remarkable elevated temperature, and when a hand etc. is put in accidentally, there is a danger of getting injured. Moreover, since a lot of ultraviolet-rays light has come out at the time of incident light fluorescence observation, when it continues basking in leakage light, there is risk of doing damage to the body. However, since a certain amount of time amount is taken to be stabilized, a lamp life also becomes short and the discharge tubes, such as a mercury-vapor lamp, do not turn to repeating flashing, it is desirable [ for this reason, at the time of unit exchange, it must cope with turning off a power source etc., but ] for as to have made the light switch on.

[0014] So, in case a unit is removed, it is possible to close the electric shutter 13 shown in drawing 1 . That is, attachment and detachment of said unit are sensed by a certain electric sensor which is not illustrated, and if it energizes to the solenoid which drives a shutter member, since the illumination light can be intercepted in the case of unit exchange, safety is secured when exchanging the unit of an optical-path lower stream of a river from a shutter.

[0015] However, since the power source of a sensor and an electric shutter is being interlocked with the power source by the side of a body when moving a shutter member electrically by sensing of an electric sensor in this way, if the power source by the side of a body is shut off, effect is not taken at all. Generally, whenever [ luminosity /, such as a mercury-vapor lamp, ],

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**EFFECT OF THE INVENTION**

[Effect of the Invention] In the lighting system which carried out unitization of the function of arbitration, the safety to the illumination light is always secured irrespective of turning on and off of a body power source in the case of unit exchange. Since reservation of this safety is performed by utilizing the electric shutter equipment used in the conventional technique, it can constitute equipment space-saving and cheaply.

[Translation done.]

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**MEANS**

[Means for Solving the Problem] Therefore, this invention is set to the lighting system for microscopes which possesses the body of a microscope which contains a field-diaphragm unit, an aperture-diaphragm unit, and a filter switch unit at least on an optical path until it results [ from the light source ] in a sample. As opposed to said body of a microscope At least one illumination-light study system unit in which attachment and detachment and exchange are possible, The electric shutter equipment which has the electro-technical element which operates electrically the shutter member which opens and closes said optical path at the time of said illumination-light study system unit insertion and detachment, and this shutter member, The lighting system for microscopes characterized by providing the mechanical device mechanically connected with said shutter member, and the external device which operates said mechanical device from the outside of said body of a microscope so that said shutter member may open and close said optical path according to insertion and detachment of said illumination-light study system unit.

[Translation done.]

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**OPERATION**

[Function] In case the body of a microscope inserts [ unit / illumination-light study system ], an optical path is mainly opened and closed by electric shutter equipment. For example, when electric shutter equipment does not operate, and an external device operates a mechanical device at the time of insertion and detachment of an illumination-light study system unit, a shutter is moved, and an optical path is opened [ since the body of a microscope is turned off ] and closed.

[Translation done.]

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EXAMPLE

[Example] With reference to an accompanying drawing, one example of this invention is explained below.

[0021] Drawing 3 shows the electric shutter equipment 40 used for the lighting system for microscopes of the 1st example of this invention. In addition, since the configuration of those other than the electric shutter equipment 40 circumference has taken the almost same configuration as the conventional lighting system explained by drawing 1 and drawing 2, the lighting system of this example explains only the configuration of the electric shutter equipment 40 circumference by this example.

[0022] This electric shutter equipment 40 has the shutter base 41. This shutter base 41 is being fixed to the body frame of a lighting system. The solenoid 42 is being fixed to this shutter base 41. This solenoid 42 has the plunger 43 and this plunger 43 is movable between the suction location by the side of a solenoid 42, and the return location which projects from a solenoid 42. If energization is made by the solenoid 42, a plunger 43 will be attracted in an electromagnetic operation of a solenoid 42 in a suction location. Between this plunger 43 and solenoid 42, the spring 44 for a return which consists of a compression coil spring is arranged. This halt of the energization to a solenoid 42 returns a plunger 43 to a return location.

[0023] The end face section of the lever 46 of the shutter member 45 is supported pivotably by the point of a plunger 43. Fitting of the shaft 48 fixed to the shutter base 41 is carried out to the section in the middle of this lever 46, and the lever 46 is supported by the shutter base 41 rotatable centering on this shaft 48. The disc-like shutter plate 50 is formed in the point of a lever 46 in one.

[0024] In the condition of not energizing to a solenoid 42, since the plunger 43 is brought to the return location according to the energization force of the spring 44 for a return, the shutter member 45 is held in the location from which it separated from the optical path as a continuous line showed drawing 3. By energizing to a solenoid 42, a plunger 43 resists the energization force of the spring 44 for a return, it is drawn in in a suction location, and the shutter member 45 moves to the location which rotates a shaft 48 as a core and is shown according to the two-dot chain line in drawing. In this location, the shutter plate 50 is inserted into an optical path, and intercepts a beam of light.

[0025] The mechanical breaker style and mechanical external device which are interlocked with such electric shutter equipment 40 are shown in drawing 4.

[0026] As shown in (A) of drawing 4, the mechanical breaker style 52 has the revolving shaft 54. Bearing of this revolving shaft 54 is carried out pivotable by the bearing 56 fixed to the body frame. The end section of this revolving shaft 54 is located near the solenoid 42, and the hook arm 58 which can contact the lever 46 of the shutter member 45 has fixed in this end section. This hook arm 58 is rotated by the revolving shaft 54 and one.

[0027] In the other end of a revolving shaft 54, the fin element 62 which has the upper part and two fins 60a and 60b which extended caudad, respectively has fixed. The end section of an extension spring 64 is connected with fin 60b of the lower part of this fin element 62. The other end of this hauling coiled spring 64 has fixed on the body of a lighting system which is not illustrated.

[0028] The push rod 68 fixed to one side face of the unit 66 of the arbitration of the exchangeable units shown in drawing 2 and contact are possible for upper fin 60a of the fin element 62. This push rod 64 constitutes a part of external device.

[0029] The operation is explained in the above configuration. The configuration of this mechanical breaker style 52 is used together with electric shutter equipment 40, is prepared, and as shown in (A) of drawing 4, in the condition that the unit 66 of arbitration is inserted in the optical path, upper fin 60a is pushed by the push rod 68, and it is in the condition of the revolving shaft 54 having pulled and having rotated against the energization force of coiled spring 64. Consequently, the hook arm 58 is estranged from the lever 46 of the shutter member 45, and electric actuation of arbitration is possible for electric shutter equipment 40.

[0030] In order to exchange a unit 66 in this condition, when a unit 66 is removed from an optical path, a push rod 68 estranges from upper fin 60a, the fin element 62 pulls, and it rotates according to the energization force of coiled spring 64. Then, as shown in (B) of drawing 4, a revolving shaft 54 rotates with the fin element 62, and, as for a revolving shaft 54 and the hook arm 58 of one, this lever 46 is rotated in contact with the lever 46 of the shutter member 45. In this case, by setting up the ability of the hauling coiled spring 64 so that the ability of the spring 44 (refer to (B) of drawing 4) for a return of a solenoid 42 may be excelled, a lever 46 is rotated until a plunger 43 reaches a suction location. That is, a lever 46 and the shutter plate 50 formed in one are inserted in an optical path, and intercepts light.

[0031] Furthermore, when the unit 66 of arbitration is inserted again, fin 60a is pushed by the tip of a push rod 68, and when the hook arm 58 rotates through the fin element 62 and a revolving shaft 54, the shutter plate 50 is automatically removed rather than an optical path according to an operation of return and the spring 44 for a return by the condition which shows the hook arm 58 in (A) of drawing 4.

[0032] According to the operation like \*\*\*\*, it is not scrupulous off, and ON of the power source of a body, and where the unit of arbitration is removed, since a shutter is closed, the safety at the time of unit exchange of arbitration is secured. Moreover, in the condition that the unit is inserted, the function of electric shutter equipment is not spoiled at all. Moreover, since the electric shutter equipment which is in an optical path conventionally is used, it ends by space-saving optically. Since such electric shutter equipment is combined with the easy mechanical device, it is cheap.

[0033] Next, the 2nd example is explained using drawing 5 thru/or drawing 7. In addition, the same reference mark is given to the same member as the thing in the 1st example, and only a different place is explained.

[0034] It is possible that it uses the configuration of the 1st example according to the \*\*\*\* application which has, generally all over an illumination-light way, arranged three units of the field-diaphragm unit 16, the aperture-diaphragm unit 15, and the filter change unit 14 at least as shown in drawing 1, and was mentioned above, combining although the mechanical breaker style 52 acts only on one specific unit. That is, safety must be secured also in case which of two or more units is detached and attached.

[0035] This example corresponds to such a request. That is, this example has the mechanical breaker style 52 which can respond to plurality 66 (66a, 66b, 66c), for example, three units, as shown in drawing 6.

[0036] The revolving shaft 54 of this device 52 is supported by two bearings 56 pivotable. As shown in (A) of drawing 6, it projects in the bottom peripheral surface of this revolving shaft 54, and the piece 70 is formed in it. The end section of the hauling coiled spring 64 is connected with this piece 70 of a protrusion.

[0037] As shown in drawing 5, three fins 60 (60a, 60b, 60c) arranged in the location corresponding to three units 66 are formed in the upper peripheral surface of a revolving shaft 54. On these fins 60, the end face section of three compression coil springs 72 (72a, 72b, 72c) has fixed, respectively. In the point of these compression coil springs 72, three pieces 74 (74a, 74b, 74c) of contact which the push rod 68 (68a, 68b, 68c) of a unit 60 can contact have fixed, respectively. By the guidance means which is not illustrated, the piece 74 of these contact is guided so that it may be movable only in the migration direction of a push rod 68. Other

configurations are the same as that of the 1st example.

[0038] The operation is shown in the above configuration. It is maintained at the condition which shows a revolving shaft 54 in (A) of (A) of drawing 6 , and drawing 7 if it is set up so that resultant force of three compression coil springs 72 may pull since the push rod 68 is pushing the piece 74 of contact as shown in (A) of drawing 5 and drawing 6 in the condition that both three units 66 are inserted in the optical path, and the ability of the spring coil 64 may be excelled, and the hook arm 58 does not affect the shutter member 45 at all.

[0039] Supposing it extracts unit 66 of one unit of arbitration, for example, center, b here, resultant force with three springs 72 will decrease. if ability of each compression coil spring 72 is set to A here and ability of the hauling coiled spring 64 is set to F --  $A+A+A>F$  and --  $A+A<F$  namely, -- If an ability setup is carried out so that it may become  $A+A<F<A+A+A$ , when a unit escapes from at least one, it pulls and the ability F of a spring 64 excels, and a revolving shaft 54 rotates, and it will rotate the hook arm 58, hooking the shutter member 45. That is, the hook arm 58 is rotated until it is maintained at the condition which shows in (B) of drawing 6 , and (B) of drawing 7 .

[0040] In this condition, the shutter plate 50 of the shutter member 45 is inserted in an optical path, and intercepts light. Moreover, it is the same operation even when a unit 66 falls out to or more two coincidence. If all three units 66 will be again inserted in an optical path, return and the shutter member 45 will be in the condition which shows a revolving shaft 54 in (A) of drawing 6 , and (A) of drawing 7 in a free condition.

[0041] According to such a device, even if a unit is plurality, safety is secured in case the unit of an arbitrary throat is exchanged. moreover -- since the electric shutter equipment originally arranged optically was used together and it has realized by the easy device -- space-saving -- and it is cheap.

[0042] Moreover, although this example explained the breaker style 52 corresponding to three units, it is clear that it can be coped with by the same device also to still more numbers than this or a small number of units.

[0043] Moreover, although the two above-mentioned examples mainly explained epi-illumination, it is completely same that it is applicable also in transmitted illumination.

[Translation done.]

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## DESCRIPTION OF DRAWINGS

### [Brief Description of the Drawings]

[Drawing 1] The side elevation showing the example of a configuration of a common optical microscope.

[Drawing 2] The perspective view showing the unit and the body of a microscope when carrying out unitization of each function of an optical microscope.

[Drawing 3] The perspective view showing the electric shutter equipment used for the 1st example of the lighting system for microscopes by this invention.

[Drawing 4] For a unit, the perspective view in which the electric shutter equipment and the breaker style in the 1st example are shown, and (A) shows the condition that the unit is inserted in the optical path, and (B) are the perspective view showing the condition of having been removed from the optical path.

[Drawing 5] The plan showing a breaker style for the electric shutter equipment in the 2nd example.

[Drawing 6] (A) is drawing in which being drawing in which being the sectional view of the VI-VI (A) line in drawing 5 , and showing a condition when three units are inserted in the optical path, and the sectional view of a VI-VI (B) line [ in / in (B) / drawing 5 ], and showing a condition when a central unit is removed from an optical path.

[Drawing 7] VII-VII in drawing 5 Drawing in which (A) shows a condition when three units are inserted in the optical path, and (B) are drawing showing a condition when it is the sectional view of a line and a central unit is removed from an optical path.

### [Description of Notations]

40 [ -- The spring for a return 45 / -- A shutter member, 52 / -- A breaker style, 54 / -- A revolving shaft, 58 / -- A hook arm, 62 / -- A fin element, 64 / -- Hauling coiled spring, 66 / -- The unit of arbitration, 68 / -- A push rod, 72 / -- Compression coil spring. ] -- Electric shutter equipment, 42 -- A solenoid, 43 -- A plunger, 44

[Translation done.]

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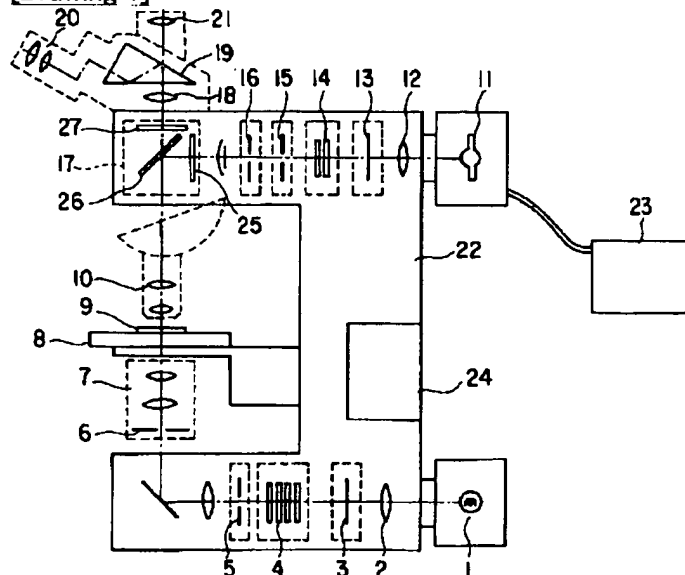
1.This document has been translated by computer. So the translation may not reflect the original precisely.

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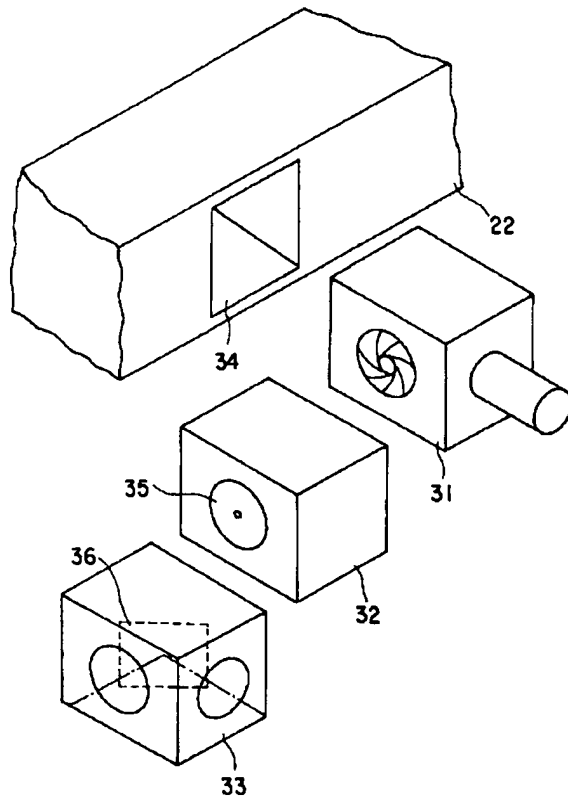
3.In the drawings, any words are not translated.

## DRAWINGS

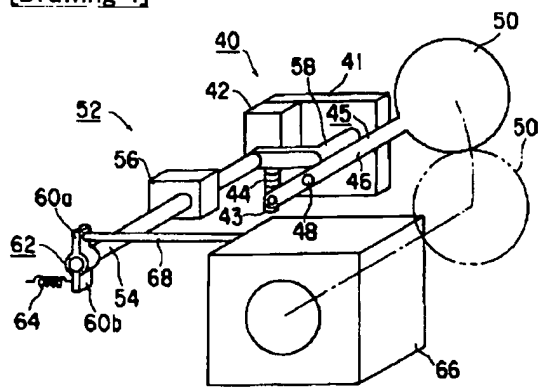
[Drawing 1]



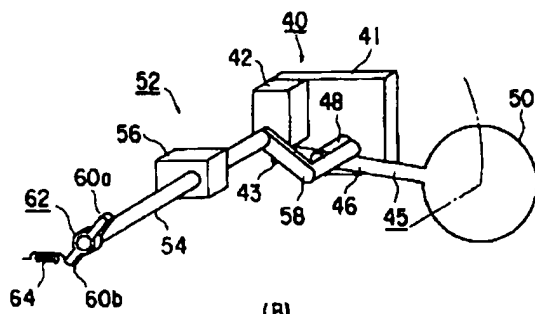
[Drawing 2]



[Drawing 4]

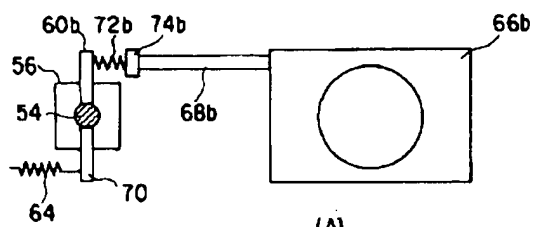


(A)

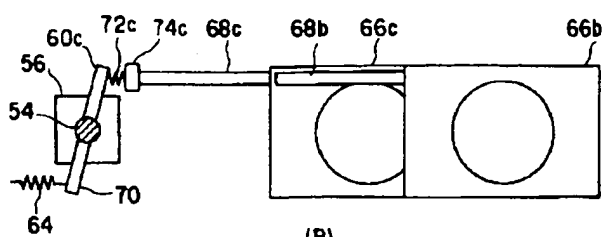


(B)

[Drawing 6]

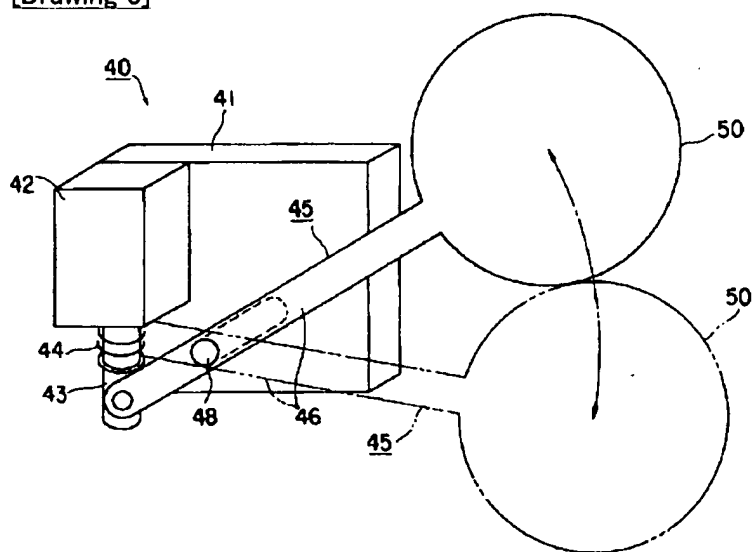


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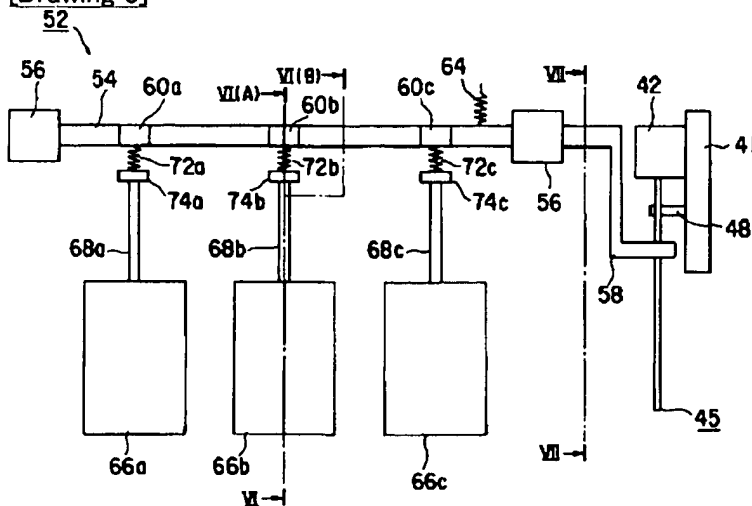


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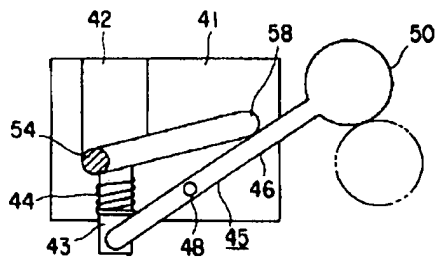
[Drawing 3]



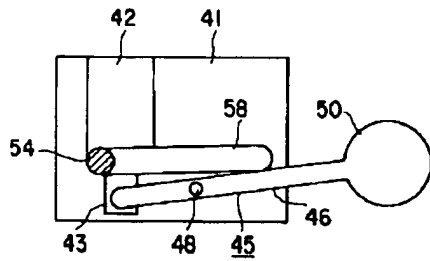
[Drawing 5]



[Drawing 7]



(A)



(B)

[Translation done.]

**全項目**

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**(57)【要約】**

【目的】簡単かつ小型の機構を用いることにより安全性を確保する。  
【構成】ソレノイド42に連結され光路を閉じるシャッタ部材45に当接可能なフックアーム58を軸54を中心として回転可能に支承する。軸54の先端にフィン要素62を取り付け、ソレノイド42の復帰用ばね44よりも付勢力の大きい引張りばね64を下方のフィン60bに連結する。例えば開口絞りユニットなどの交換可能な任意のユニット66の一侧に、上方のフィン60aに当接可能な押し棒68を取り付ける。

**【特許請求の範囲】**

【請求項1】光源から標本に至るまでの光路上に少なくとも視野絞りユニットと開口絞りユニットとフィルター切り換えユニットとを含む顕微鏡本体を具備する顕微鏡用照明装置において、前記顕微鏡本体に対し着脱及び入れ替え可能な少なくとも1つの照明光学系ユニットと、前記照明光学系ユニット挿脱時に前記光路を開閉するシャッタ部材とこのシャッタ部材を電氣的に作動させる電氣的要素とを有する電動シャッタ装置と、前記シャッタ部材に機械的に連結された機械的機構と、前記照明光学系ユニットの挿脱に応じて前記シャッタ部材が前記光路を開閉するように前記機械的機構を前記顕微鏡本体の外部から操作する外部装置とを具備することを特徴とする顕微鏡用照明装置。

**【発明の詳細な説明】**

【0001】

【産業上の利用分野】本発明は、シャッタ装置を備えた光学顕微鏡用の照明装置に関する。

【0002】

【従来の技術】従来、光学顕微鏡の中でも、特に落射蛍光観察において、蛍光観察時の試料への蛍光の過剰照射による褪色防止や標本に対する保護の観点から照明光制御のために照明光学系の光路を開閉するシャッタ装置が設けられるのが一般的である。

【0003】例えば、フィルターブロックとシャッタ装置のシャッタ部材との間に連動装置を設け、人間の与える外部からの力により機械的にシャッタ部材の開閉を行えなるシャッタ装置が実開昭62-16911号公報(以下、「第1の従来例」と称す)に開示されている。

【0004】また、外部装置を用いて電氣的に機械的な機構を操作し、シャッタの開閉を行なえる電動シャッタ装置が特開昭63-189847号公報(以下、「第2の従来例」と称す)に開示されている。

【0005】さらに第2の従来例を改良して何らかのセンサーにより動作する電動シャッタ装置もある。

【0006】次に一般的な光学顕微鏡の構成例を図1に示す。

【0007】符号1及び符号11は例えばハロゲンランプや水銀ランプの如き光源、符号2及び符号12はコレクターレンズ、符号3及び符号13は例えば第2の従来例に開示されている様な公知の照明光制御用電動シャッタ、符号4及び符号14は調光用のフィルター、符号5及び符号16は視野絞り、符号6及び符号15は開口絞り、符号7はコンデンサーレンズ、符号8はステージ、符号9は標本、符号10は対物レンズを、夫々示す。又、符号17は検鏡法に応じ光路中に切換挿脱可能に保持されたキューブユニットを示し、このユニットとしては例えば蛍光キューブ(励起フィルター、ダイクロイックミラー、吸収フィルター)や、落射明視野キューブ(ハーフミラー)、或いは落射暗視野キューブ(絞り、ミラー)などがある。符号18は結像レンズ、符号19は必要に応じて光路を観察系または写真撮影系に切り換えるために光路中に挿脱可能に配置されたビームスプリッタ、符号20は接眼レンズ、符号21は写真撮影用接眼レンズ、符号22は顕微鏡フレーム、符号23は光源11の電源、符号24は本体電源を示す。

【0008】通常の落射蛍光観察を行なう場合、光源11より出た光はコレクターレンズ12により集光され、シャッタ13に導かれここで開閉により制御される。開いた状態になれば開口絞り15及び視野絞り16を通過してキューブユニット17の一例である蛍光キューブに導びかれる。この蛍光キューブは、励起フィルター25と、ダイクロイックミラー26と、吸収フィルター27とを備えている。視野絞り16に導びかれた光は、吸収フィルター27を通りダイクロイックミラー26により反射され、対物レンズ10により標本9に導びかれこの標本9を励起する。この標本9より発した蛍光は対物レンズ10により集光され、ダイクロイックミラー26及び吸収フィルター27を通過し、結像レンズ18により集光され、図示しない接眼光学系または写真光学系に導びかれる。

【0009】上述の構成における照明光学系の中でも視野絞り5、16及び開口絞り6、15は固定されているのが一般的である。一方、交換可能な照明光学系キューブユニットとしては前述したように蛍光キューブ、落射明視野キューブ、落射暗視野キューブなどがあげられる。

【0010】通常上記のような構成で観察が行われるが、アプリケーションによっては特別な構成が取られる場合が考えられる。例えば、標本上の励起光照射範囲を極度に限定したい場合には、通常の視野絞りでは最小径に限界があるため視野絞り16のかわりにピンホールが置かれる。また、観察以前にレーザ等により標本に何らかの操作を与えたい場合(Fluorescence Recovery after Photobleaching等)などは、照明光路途中からレーザ等の照明を入れてやるために、光路中にハーフミラーやダイクロイックミラーなどが置かれる。また蛍光観察以外で上記照明光学系を用いる場合、標本からの蛍光にコントラストをつける時がある。コントラストを得るためには、通常、開口絞りを絞り込むが、高倍の対物レンズなどを使用する場合にはさらに効果を上げるために、開口絞りの位置にピンホールを置くことがある。

【0011】これらのアプリケーションを満足するには、図2に示す様に、各機能をユニット構成とすれば、本体フレーム22に対してユニットごと入れ換える事により容易に構成が変えられるばかりではなく、本出願人による特願平3-317100号の如き機能も容易に追加することができる。図2の符号31は開口絞り15又は視野絞り16を含み図示しない開閉機構も含んだ絞りユニット、符号32はピンホール35を含んだピンホールユニット、符号33はハーフミラー又はダイクロイックミラー36を含んだミラーユニットを示す。これらユニットを本体フレームの取付け部34に取り付けることで、照明光路中に挿入され、前述の様な種々のアプリケーションに対応した光学的機能を果たす。

【0012】なお、図2に示すアプリケーションは一例であり、光路中に挿脱する事で機能を果たす物

であれば良い。

【0013】ここで上記ユニットを取り外した状態を考えると、本体フレーム側は取付け部34の穴が開いており、光路が剥き出しとなっている。この場合に光源11が点灯した状態であると、特に水銀灯の様な高輝度、高エネルギーのものを光源11として使用した場合、光路中はかなりの高温になっており、誤って手等を入れた場合火傷を負う危険性がある。また、落射蛍光観察時には多量の紫外線光が出ているので、漏れ光を浴び続けると人体に害を及ぼす危険がある。しかしこの為、ユニット交換時には電源を消す等の対策を行わなければならないが、水銀灯などの放電管は安定するまでにある程度の時間を要し、ランプ寿命も短くなるので、点滅を繰り返すのには向かないため、点灯させたままが望ましい。

【0014】そこでユニットを取り外す際には図1に示す電動シャッタ13を閉じることが考えられる。即ち、前記ユニットの着脱を、図示しない何らかの電氣的センサーにより感知し、シャッタ部材を駆動するソレノイドに通電すれば、ユニット交換の際に照明光が遮断できるので、シャッタより光路下流のユニットを交換する時には安全性は確保される。

【0015】しかしながら、このように電氣的センサーの感知により電氣的にシャッタ部材を動かす場合、センサー及び電動シャッタの電源は本体側の電源と連動しているので、本体側の電源が切られていると何ら効果を示さない。一般に水銀灯等の光輝度光源は、独立した電源23を持っており、本体の電源とは無関係に点灯可能となる。また電気生理学など標本の微小電流を計測する分野では、ノイズとなるため本体の電源は切って観測が行なわれる。このように本体の電源を切って使用する状況下では、ユニット交換時に電氣的操作によって安全性を確保することはできない。

【0016】また、電氣的な手段を用いずに機械的な機構のみを用いたシャッタ装置は操作性が悪く、光源がついたままシャッタをおろさないで、即ち光源をつけたまま光路を開いた状態にして、ユニット交換してしまう可能性がある。

【0017】本発明は以上のような実情に鑑みてなされたもので、従来の技術の効果を保ちつつ簡単かつ小型の機構を用いることにより安全性の確保された顕微鏡用照明装置を提供することを目的とする。詳細には、開口絞りや視野絞りがユニット構成をとり、ダイクロイックミラーなど照明光学系キューブユニットと交換が可能であり、電源に関係なくユニット交換時に連動して必ずシャッタが開閉して、検鏡上または人体に害のある光源と害のない光源との漏れ光を放射させないような、構成が簡単で機械的な機構の電動シャッタを具備する顕微鏡用照明装置を提供することを目的とする。

【0018】

【課題を解決するための手段】従って本発明は、光源から標本に至るまでの光路上に少なくとも視野絞りユニットと開口絞りユニットとフィルター切り換えユニットとを含む顕微鏡本体を具備する顕微鏡用照明装置において、前記顕微鏡本体に対し着脱及び入れ替え可能な少なくとも1つの照明光学系ユニットと、前記照明光学系ユニット挿脱時に前記光路を開閉するシャッタ部材とこのシャッタ部材を電氣的に作動させる電氣的要素とを有する電動シャッタ装置と、前記シャッタ部材に機械的に連結された機械的機構と、前記照明光学系ユニットの挿脱に応じて前記シャッタ部材が前記光路を開閉するように前記機械的機構を前記顕微鏡本体の外部から操作する外部装置とを具備することを特徴とする顕微鏡用照明装置。

【0019】

【作用】照明光学系ユニットが顕微鏡本体に挿脱される際には主に電動シャッタ装置によって光路が開閉される。例えば顕微鏡本体の電源が切られているために電動シャッタ装置が作動しない場合には、照明光学系ユニットの挿脱時に外部装置が機械的機構を操作することによりシャッタが移動され光路が開閉される。

【0020】

【実施例】以下に添付図面を参照して本発明の一実施例を説明する。

【0021】図3は本発明の第1実施例の顕微鏡用照明装置に用いられる電動シャッタ装置40を示す。なお本実施例の照明装置は、電動シャッタ装置40周辺以外の構成は図1及び図2で説明した従来の照明装置とほぼ同様の構成を取っているため、本実施例では電動シャッタ装置40周辺の構成のみを説明する。

【0022】この電動シャッタ装置40はシャッタベース41を有している。このシャッタベース41は照明装置の本体フレームに固定されている。このシャッタベース41にはソレノイド42が固定されている。このソレノイド42はプランジャ43を有しており、このプランジャ43はソレノイド42側の吸引位置とソレノイド42から突出する復帰位置との間で移動可能となっている。ソレノイド42に通電が

なされるとソレノイド42の電磁的作用でプランジャ43は吸引位置に吸引される。このプランジャ43とソレノイド42との間には圧縮コイルばねよりなる復帰用ばね44が配置されている。これによってソレノイド42への通電が停止されるとプランジャ43は復帰位置に復帰する。

【0023】プランジャ43の先端部には、シャッタ部材45のレバー46の基端部が枢支されている。このレバー46の途中部には、シャッタベース41に固定された軸48が嵌合されており、この軸48を中心としてレバー46はシャッタベース41に回転可能に支持されている。レバー46の先端部には円板状のシャッタ板50が一体的に形成されている。

【0024】ソレノイド42に通電しない状態では、プランジャ43は復帰用ばね44の付勢力によって復帰位置にもたらされているので、シャッタ部材45は図3において実線で示すように光路から外れた位置に保持されている。ソレノイド42に通電することにより、プランジャ43が復帰用ばね44の付勢力に抗して吸引位置に吸引され、シャッタ部材45が軸48を中心として回転して図中2点鎖線で示す位置に移動する。この位置では、シャッタ板50が光路内に挿入され、光線を遮断する。

【0025】このような電動シャッタ装置40に連動する機械的な開閉機構及び外部装置を図4に示す。

【0026】図4の(A)に示すように、機械的開閉機構52は、回転軸54を有している。この回転軸54は本体フレームに固定された軸受け56によって回転可能に支承されている。この回転軸54の一端部はソレノイド42の近傍に位置しており、この一端部にはシャッタ部材45のレバー46に当接可能なフックアーム58が固着されている。このフックアーム58は回転軸54と一体で回転するようになっている。

【0027】回転軸54の他端部には、上方及び下方に夫々延出した2個のフィン60a、60bを有するフィン要素62が固着されている。このフィン要素62の下方のフィン60bには引張りコイルばね64の一端部が連結されている。この引張りコイルばね64の他端部は図示しない照明装置本体に固着されている。

【0028】フィン要素62の上方のフィン60aは、図2に示す交換可能なユニットのうちの任意のユニット66の一側面に固定された押し棒68と当接可能となっている。この押し棒68は、外部装置の一部を構成している。

【0029】以上の構成においてその作用を説明する。この機械的開閉機構52の構成は、電動シャッタ装置40と併用して設けられており、図4の(A)に示すように任意のユニット66が光路に挿入されている状態においては、押し棒68により上方のフィン60aが押され、回転軸54が引張りコイルばね64の付勢力に反して回転された状態となっている。この結果、フックアーム58はシャッタ部材45のレバー46から離間しており、電動シャッタ装置40は任意の電氣的な操作が可能となっている。

【0030】この状態でユニット66を交換するためにユニット66を光路より外したときには、押し棒68が上方のフィン60aから離間し、フィン要素62が引張りコイルばね64の付勢力により回転する。すると、図4の(B)に示すように、回転軸54がフィン要素62と共に回転され、回転軸54と一体のフックアーム58はシャッタ部材45のレバー46に当接してこのレバー46を回転させる。この場合、ソレノイド42の復帰用ばね44(図4の(B)参照)の力量に勝る様に引張りコイルばね64の力量を設定しておくことで、レバー46はプランジャ43が吸引位置に至るまで回転される。即ち、レバー46と一体的に形成されたシャッタ板50は光路に挿入され光を遮断する。

【0031】更に再度任意のユニット66を挿入した時には、押し棒68の先端によりフィン60aが押され、フィン要素62及び回転軸54を介してフックアーム58が回転されることによりフックアーム58は図4の(A)に示す状態に戻り、復帰用ばね44の作用によりシャッタ板50は自動的に光路より外れる。

【0032】以上の如き作用により、本体の電源のオン、オフに拘らず、任意のユニットを外した状態ではシャッタが閉まるため、任意のユニット交換時の安全性は確保される。また、ユニットが挿入されている状態では、電動シャッタ装置の機能は何ら損なうことはない。また、従来より光路中に在る電動シャッタ装置を利用しているため、光学的に省スペースですむ。この様な電動シャッタ装置を簡単な機械的機構と組合せているので安価である。

【0033】次に第2実施例を図5乃至図7を用いて説明する。なお第1実施例におけるものと同一の部材には同一の参照符号を付し、異なるところのみを説明する。

【0034】第1実施例の構成は特定の1個のユニットにのみに機械的開閉機構52が作用するが、図1に示すように照明光路中には一般的に少なくとも視野絞りユニット16と、開口絞りユニット15と、フィルター切換えユニット14との3ユニットを配置することができ、前述した如きアプリケーション

ンに応じて組み合わせて使用することが考えられる。つまり、複数のユニットのどれを着脱する際にも安全性が確保されなければならない。

【0035】本実施例はこの様な要望に対応するものである。即ち本実施例は、図6に示すように、複数例えば3つのユニット66(66a, 66b, 66c)に対応可能な機械的開閉機構52を有している。

【0036】この機構52の回転軸54は、2つの軸受け56によって回転可能に支持されている。この回転軸54の下周面には、図6の(A)に示すように突出片70が形成されている。この突出片70には、引っ張りコイルばね64の一端部が連結されている。

【0037】図5に示すように、回転軸54の上周面には3つのユニット66に対応する位置に配置された3つのフィン60(60a, 60b, 60c)が形成されている。これらフィン60には、3つの圧縮コイルばね72(72a, 72b, 72c)の基端部が夫々固着されている。これら圧縮コイルばね72の先端部には、ユニット60の押し棒68(68a, 68b, 68c)が当接可能な3つの当接片74(74a, 74b, 74c)が夫々固着されている。これら当接片74は、図示しない案内手段によって押し棒68の移動方向にのみ移動可能なように案内されている。その他の構成は第1実施例と同様である。

【0038】以上の構成においてその作用を示す。3つのユニット66が共に光路に挿入されている状態では、図5及び図6の(A)に示すように押し棒68が当接片74を押しているため、3つの圧縮コイルばね72の合力が引っ張りばねコイル64の力量に勝るように設定されていれば、回転軸54は図6の(A)及び図7の(A)に示す状態に保たれ、フックアーム58はシャッタ部材45に何ら影響を与えない。

【0039】ここで任意の1ユニット、例えば中央のユニット66bを抜いたとすると、3つのばね72による合力が減少する。ここで各々の圧縮コイルばね72の力量をAとし、引っ張りコイルばね64の力量をFとすると、 $A+A+A>F$  かつ  $A+A<F$  即ち  $A+A<F<A+A+A$ となるよう力量設定されているのであれば、ユニットが1つでも抜けた場合には引っ張りばね64の力量Fが勝り、回転軸54は回転し、フックアーム58はシャッタ部材45を引っ掛けながら回転する。即ちフックアーム58は図6の(B)及び図7の(B)に示す状態に保たれるまで回転する。

【0040】この状態では、シャッタ部材45のシャッタ板50は光路に挿入され光を遮断する。また、ユニット66が2つ以上同時に抜けた場合でも同じ作用である。再度光路にユニット66が3つとも挿入された状態になれば、回転軸54は図6の(A)及び図7の(A)に示す状態に戻り、シャッタ部材45はフリーな状態となる。

【0041】このような機構によれば、ユニットが複数であっても、任意のどのユニットを交換する際においても安全性は確保される。また、本来光学的に配置された電動シャッタ装置を併用し、簡単な機構で実現しているので、省スペースかつ安価である。

【0042】また、本実施例では3つのユニットに対応する開閉機構52を説明したが、さらにこれより多い数または少ない数のユニットに対しても同様の機構で対処できるのは明らかである。

【0043】また、上記2つの実施例は落射照明を主に解説したが、透過照明においても適用できることは全く同様である。

【0044】

【発明の効果】任意の機能をユニット化した照明装置においてユニット交換の際に照明光に対する安全性が本体電源のオン・オフにかかわらず常に確保される。この安全性の確保は、従来技術において用いられていた電動シャッタ装置を活用して行われるので、省スペースかつ安価に装置を構成することができる。

#### 【図面の簡単な説明】

【図1】一般的な光学顕微鏡の構成例を示す側面図。

【図2】光学顕微鏡の各機能をユニット化したときのユニット及び顕微鏡本体を示す斜視図。

【図3】本発明による顕微鏡用照明装置の第1実施例に用いられる電動シャッタ装置を示す斜視図。

【図4】第1実施例における電動シャッタ装置と開閉機構とを示し、(A)はユニットが光路に挿入されている状態を示す斜視図、(B)はユニットが光路から取り外された状態を示す斜視図。

【図5】第2実施例における電動シャッタ装置を開閉機構とを示す上面図。

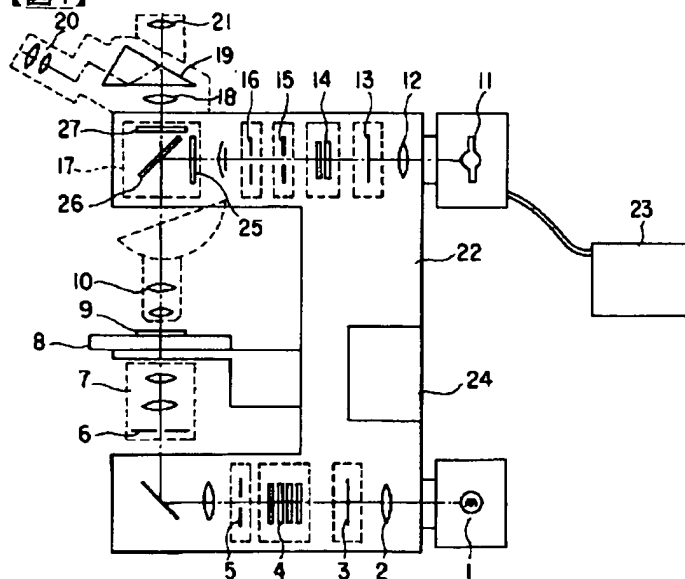
【図6】(A)は図5におけるVI-VI(A)線の断面図であり、3つのユニットが光路に挿入されている時の状態を示す図、(B)は図5におけるVI-VI(B)線の断面図であり、中央のユニットが光路から取り外された時の状態を示す図。

【図7】図5におけるVII-VII線の断面図であり、(A)は3つのユニットが光路に挿入されている時の状態を示す図、(B)は中央のユニットが光路から取り外された時の状態を示す図。

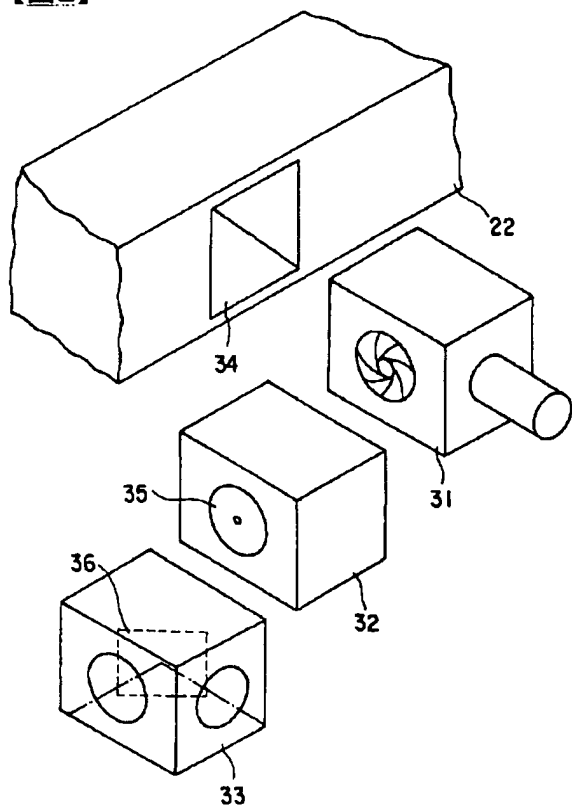
【符号の説明】

40…電動シャッタ装置、42…ソレノイド、43…プランジャ、44…復帰用ばね、45…シャッタ部材、52…開閉機構、54…回転軸、58…フックアーム、62…フィン要素、64…引っ張りコイルばね、66…任意のユニット、68…押し棒、72…圧縮コイルばね。

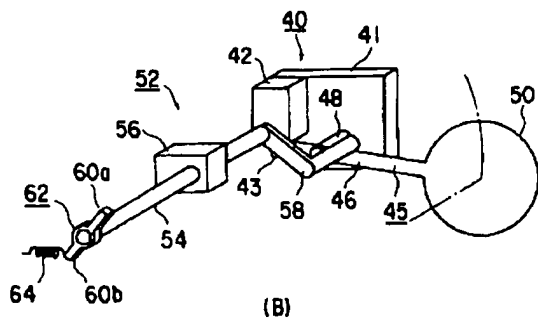
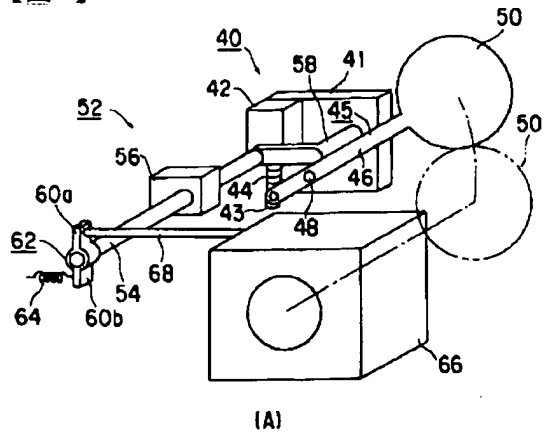
【図1】



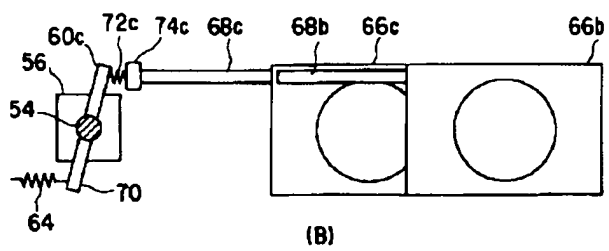
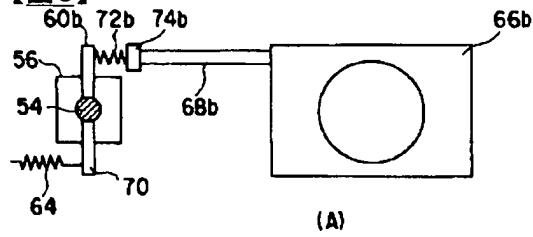
【図2】



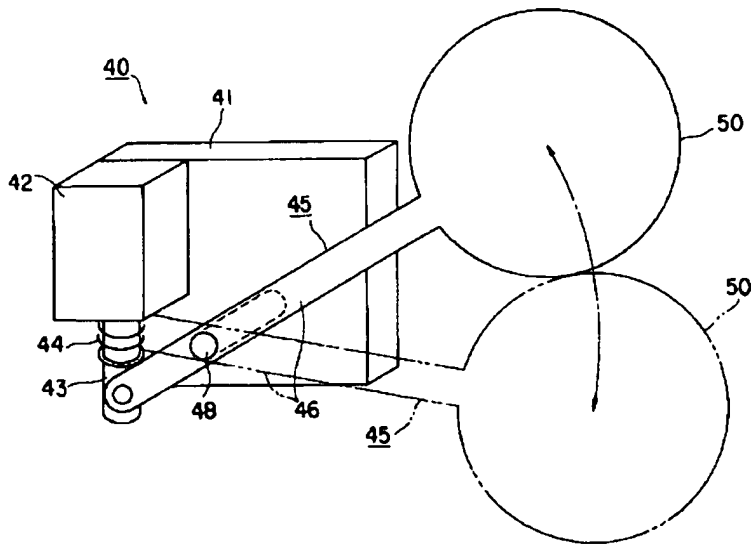
【図4】



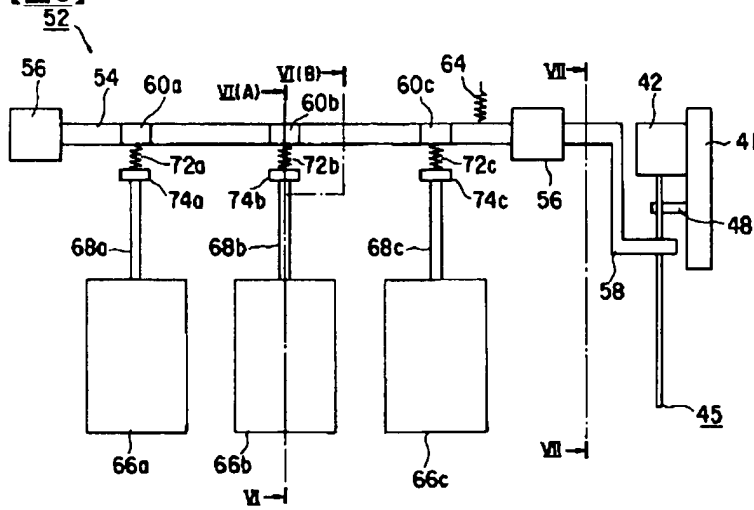
【図6】



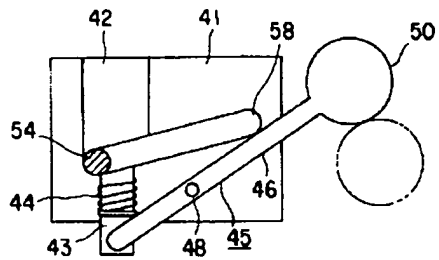
【図3】



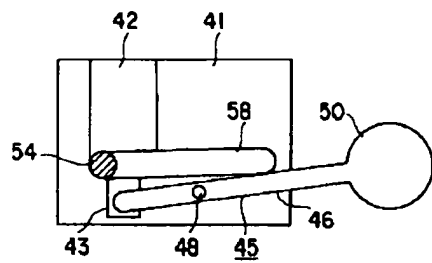
【図5】



【図7】



(A)



(B)